

# COMPREHENSIVE EVERGLADES RESTORATION PLAN

# LOXAHATCHEE RIVER WATERSHED RESTORATION PROJECT (LRWRP)

INTEGRATED PROJECT IMPLEMENTATION REPORT & ENVIRONMENTAL IMPACT STATEMENT  
Performance Measure Output

Presented by:

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South Florida Water Management District

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# Overview of Agenda

- Project Objectives and Performance Measures (PM)
- Restoration Benefits (What are Habitat Units?)
- Watershed Hydrology Performance (Wetland Rapid Assessment Procedure PM 4)
- Watershed Connectivity Performance (Connectivity PM 9)
- River Flood Plain, River, Estuary Performance (Flows and Salinity PM 1) – Patti Gorman
- Benefits Summary of Alternatives (Habitat Units)



# Objectives and PM Table

Objective (Abbreviated)	PM 1 – Salinity	PM 4 – Watershed Hydrology	PM 9 - Connectivity
1. Restore wet and dry season flows to Northwest Fork of Loxahatchee River	√		
2. Restore and/or maintain estuarine communities (oysters, fish, seagrass)	√		
3. Increase natural area extent of wetlands (improve natural, restore ag.)		√	
4. Restore connections between natural areas			√
5. Restore native plant and animal species abundance and diversity		√	√



# Ecosystem Focus Areas and PMs

Ecosystem Focus Area	PM 1	PM 4	PM 9
Watershed Wetlands – Freshwater Flora and Fauna		√	√
Cypress Swamp-River Floodplain - Freshwater Flora and Fauna	√		√
River with Tape Grass <sup>1</sup> and Fish Larvae	√		
Estuary – Fish, Oysters, Seagrass	√		

<sup>1</sup> Tape Grass – (*Vallisneria americana*)



Slough Fishing



Cypress in the Floodplain



Tape Grass Beds



Seagrass Monitoring

# What are Habitat Units? & Why do we use them?

- A Tentatively Selected Plan (TSP) is justified by ecological restoration benefits; however a comparison of the benefits and costs of alternative plans is conducted to ensure that the TSP is cost effective.
- Habitat Units are used as input to the Cost Effectiveness Incremental Cost Analysis (CE/ICA) per ER 1105-2-100 (Planning Guidance Notebook) to compare the alternative plans' average annual cost against the average annual Habitat Unit estimates
  - Screens out alternative plans that are not cost effective
  - Reveals changes in cost for increasing levels of environmental output (Habitat Units)
  - Helps decision makers answer the question.....**“Is it worth it?”**.....**“Are the additional Habitat Unit outputs worth the costs incurred to achieve them?”**



# What are Habitat Units? & Why do we use them?

- Habitat Units are a metric to predict environmental benefits. Habitat Quality Index (HSI): Measured over a geographic area (scores assigned 0 = worst and 1 = best)
  - Quantity = Acres
  - Quantity x Quality = Habitat Units
- Habitat Units are calculated using project performance measures
  - Developed through interagency PDT
  - Leverage RECOVER (System-wide Science Team)
- Regional hydrologic models used to calculate performance measures and estimate changes in hydrology. Lower East Coast Sub-Regional Model (LECsR) used for the Loxahatchee River Watershed Restoration Project.



# PM 4: REVISED INDICATOR REGIONS (IRS) BY FLOWWAY

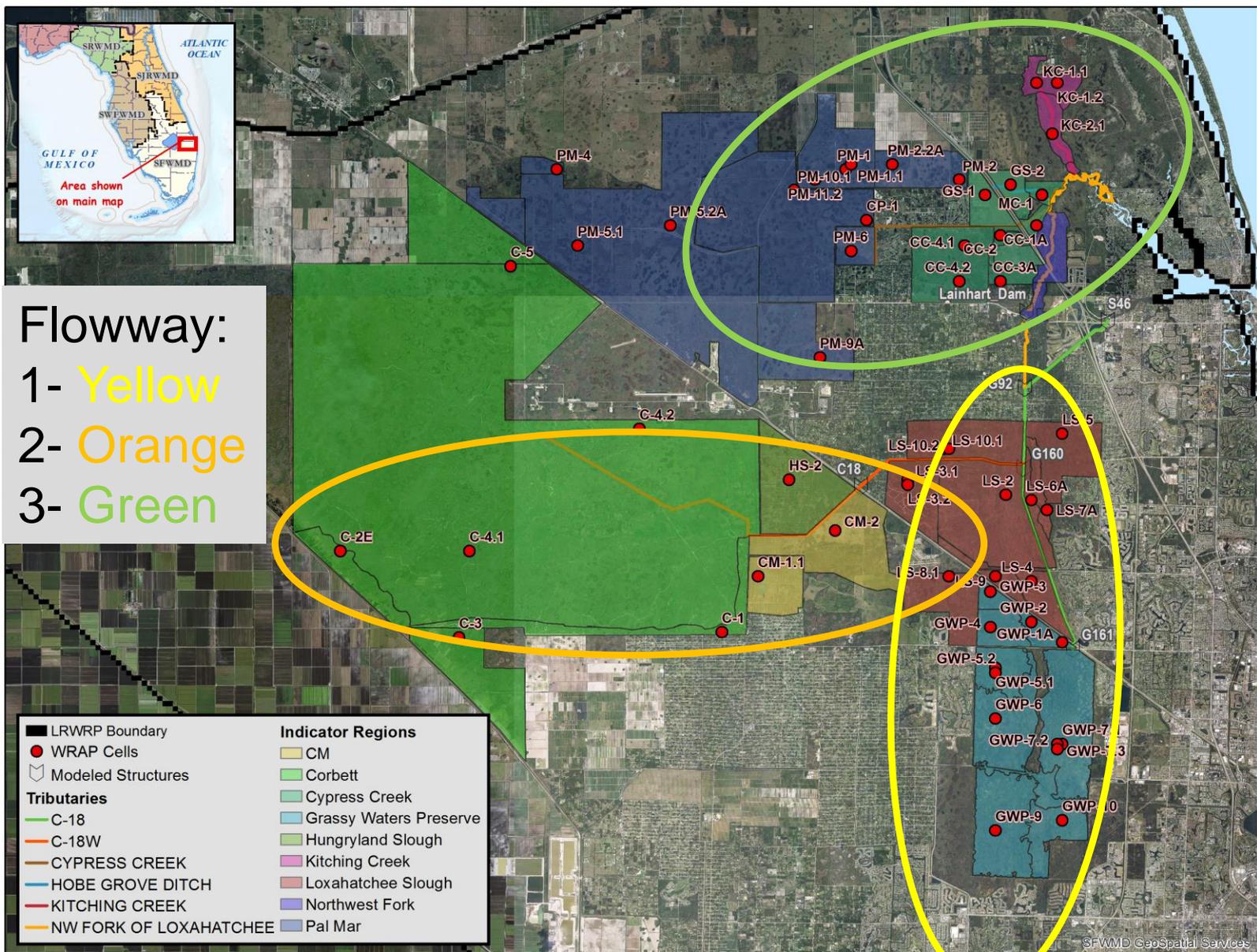


Flowway:

1- Yellow

2- Orange

3- Green



- Flowway 3
- KC- Kitching Creek
- MC – Moonshine Creek
- CC – Cypress Creek
- PM – Pal Mar

- Flowway 2
- CM – C18 Mecca
- C- Corbett Wildlife Manage Area

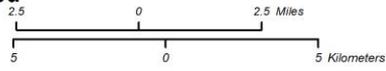
- Flowway 1
- LS- Lox Slough
- GWP – Grassy Waters Preserve

LRWRP Boundary	<b>Indicator Regions</b>
WRAP Cells	CM
Modeled Structures	Corbett
<b>Tributaries</b>	Cypress Creek
C-18	Grassy Waters Preserve
C-18W	Hungryland Slough
CYPRESS CREEK	Kitching Creek
HOBE GROVE DITCH	Loxahatchee Slough
KITCHING CREEK	Northwest Fork
NW FORK OF LOXAHATCHEE	Pal Mar

Loxahatchee River Watershed Restoration Project Modeling Results



BASE CREDITS:  
State plane projection, Florida east zone, NAD 83-HARN, US feet.  
South Florida Water Management District  
3301 Gun Club Rd., West Palm Beach, Florida 33406  
(561) 666-8800; www.sfwmd.gov



Map Date: April 2017  
wad.sfwmd.gov/dfs/root/GS/IGS/Bz/WS/LRWRP/mxd/LRWRP\_wrappells.mxd



# PM 4 – IDENTIFIED MAJOR PLANT COMMUNITIES USED IN WETLAND RAPID ASSESSMENT PROCEDURE (WRAP)

Plant Community Type	Annual Avg. Water Depth (inches)	Inundation Duration* (days/yr)	Median Inundation Duration (days/yr)
Mesic Flatwood	Below ground	≤30	15
Mesic (Oak) Hammock	Below ground	0-60	30
Hydric Flatwood	0-6	30-60	45
Hydric Hammock	0-6	30-60	45
Depression Marsh	12-24	180-300	240
Wet Prairie	6-16	60-180	120
Strand Swamp	18-36	210-300	255
Floodplain Swamp	12-30	120-240	180
Dome Swamp	12-24	210-300	255

\* Frequency coincides with wet weather patterns and existing groundwater conditions

**Table - 1.** Annual average water depth and annual inundation for major wetland plant communities identified within the Loxahatchee watershed.



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## PM 4 – EVALUATING HYDROLOGIC IMPROVEMENTS

LS-3 (an evaluation cell in the Loxahatchee Slough indicator region 3) is a Depression Marsh. The median value is 240 days/year inundation

In order for LS-3 to get a WRAP index score of 1 (highest value), LECsR (Lower East Coast Sub Regional Model) Model output would have to equal  $240 \text{ days} \times 41 \text{ years} = 9,840 \text{ days}$  over the period of record.

Example: Model output for Alternative 13 is 5,844 days.  
Divide by 9,840 = an initial score of 0.59.



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# PM-4: SCALING ECOLOGICAL CONDITION (NON-LINEAR) AND CALCULATING HABITAT UNITS

Weighting Factor added to correctly scale ecological condition (non-linear) using WRAP score (linear)

WRAP Score	Weighting Factor
0.85-1.0	1.0
0.70-0.84	0.75
0.55-0.69	0.5
0.40-0.54	0.25
<0.40	0.1

• **WRAP score<sup>x</sup> \* Weighting factor<sup>x</sup> = Scaled Score<sup>x</sup>**

LS-3 for Alt 13:  $0.59 * 0.5 = 0.3$

• **Scaled Score<sup>x</sup> \* Area<sup>x</sup> = Habitat Units<sup>x</sup>**

LS-3 for Alt 13:  $0.3 * 1,451 = 431$  Habitat Units



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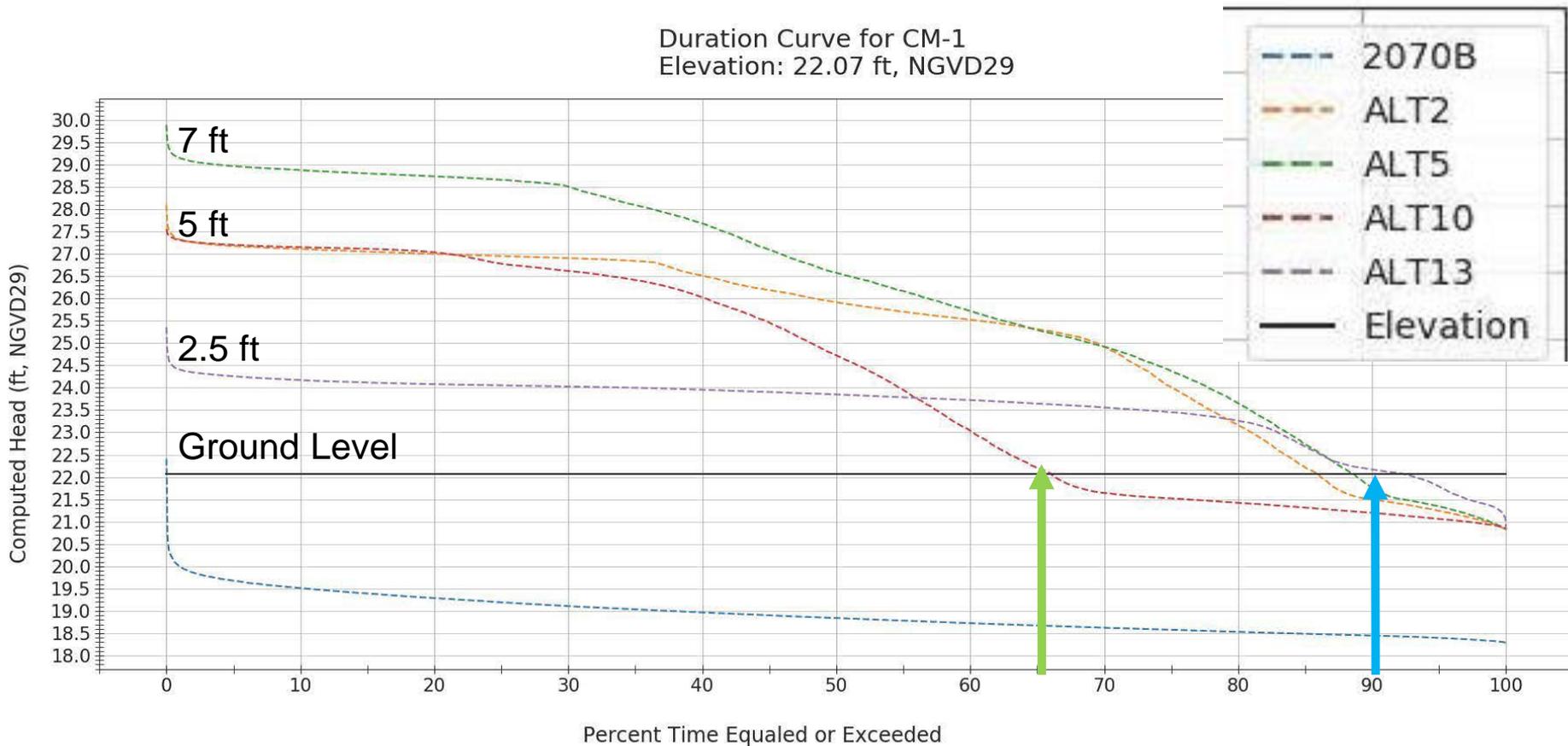
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# PM-4 UPDATES AND TAKE HOME POINTS

Indicator Region	WRAP Cell Name	LECSR CELL ID	Acres	Dominant Vegetation	Target Inundation	FW Designation	ECB WRAP Hydro score	WL Type Upper Range Ratio	ECB Inundation (est.)	2014 ECB (APR 2018)	PM 4 Initial Score	PM Functional Scaling Score	PM4 Score Scaled	ECB Habitat Units
C-1	C-1	203,288	1,642	DM	9,840	FW2	2.00	1.25	6560	7296	0.74	0.75	0.56	913
C-2	C-2E	187,214	1,226	DM	9,840	FW2	2.00	1.25	13117	12879	1.31	0.73	0.96	1171
C-3	C-3	204,237	2,806	DS	10,455	FW2	1.00	1.18	3485	2015	0.19	0.10	0.02	54
C-4	C-4.1	187,239	25,500	DM	9,840	FW2	2.50	1.25	8200	4805	0.49	0.25	0.12	3113
C-4	C-4.2								8200	8397	0.00	0.10	0.00	0
C-5	C-5	131,247	3,170	DM	9,840	FW3	2.50	1.25	8200	6093	0.62	0.50	0.31	981
CC-1	CC-1A	123,349	202	FS	7,380	FW3	1.00	1.33	2460	108	0.01	0.10	0.00	0
CC-2	CC-2	125,342	557	FS	7,380	FW3	0.50	1.33	1230	102	0.01	0.10	0.00	1
CC-3	CC-3A		394	WP	4,920	FW3	2.50	1.50	4100	1213	0.25	0.10	0.02	10
CC-4	CC-4.1	127,335	2,542	DM	9,840	FW3	1.50	1.25	4920	32	0.00	0.10	0.00	1
CC-4	CC-4.2					FW3			4920	3241	0.00	0.10	0.00	0
CM-1	CM-1.1	192,295	1,381	DM	9,840	FW2	0.50	1.25	1640	3	0.00	0.10	0.00	0
CM-2	CM-2	183,310	3,191	DM	9,840	FW2	0.50	1.25	1640	11656	1.18	0.84	1.00	3191
pal mar	CP-1	122,316	642	DM	9,840	FW3	1.50	1.25	4920	1018	0.10	0.10	0.01	7
pal mar	CP-2		642	DM	9,840			1.25		427	0.04	0.10	0.00	3
GS-1	GS-1	117,339	543	DM	9,840	FW3	0.50	1.25	1640	0	0.00	0.10	0.00	0
GS-2	GS-2		737	DM	9,840	FW3		1.25	1640	0	0.00	0.10	0.00	0
GWP-10	GWP-10	240,354	1,107	DS	10,455		3.00	1.18	10455	14436	1.38	0.62	0.85	943
GWP-1	GWP-1A	205,354	42	DS	10,455	FW1	1.50	1.18	5228	13305	1.27	0.73	0.92	39
GWP-2	GWP-2	201,348	397	DS	10,455	FW1	2.00	1.18	6970	7788	0.74	0.75	0.56	222
GWP-3	GWP-3	195,340	308	DS	10,455	FW2	2.00	1.18	6970	14227	1.36	0.64	0.86	266
GWP-4	GWP-4	202,340	755	DS	10,455	FW2	3.00	1.18	10455	12457	1.19	0.83	0.99	745
GWP-5	GWP-5.1	210,341	977	DS	10,455		2.50	1.18	8713	10244	0.98	1.00	0.98	957
GWP-5	GWP-5.2								9591	0.00	0.10	0.00	0	
GWP-6	GWP-6	220,341	2,134	DS	10,455		3.00	1.18	10455	14762	1.41	0.59	0.83	1778
GWP-7	GWP-7.1	225,354	2,992	DS	10,455		3.00	1.18	10455	13968	1.34	0.66	0.88	2635
GWP-7	GWP-7.2		2,992	DS	10,455			1.18	10455	14182	1.36	0.64	0.87	2595
GWP-7	GWP-7.3		2,992	DS	10,455			1.18	10455	13077	1.25	0.75	0.94	2814
GWP-9	GWP-9	242,341	2,518	DS	10,455		3.00	1.18	10455	13738	1.31	0.68	0.90	2254



# UPDATE 1: C-18 WEST IMPOUNDMENTS – NO HABITAT UNITS



- No Habitat Units: Alt 2, 5, 10, ECB/FWO
- Habitat Units Alt 13 – 1229 out of 1381



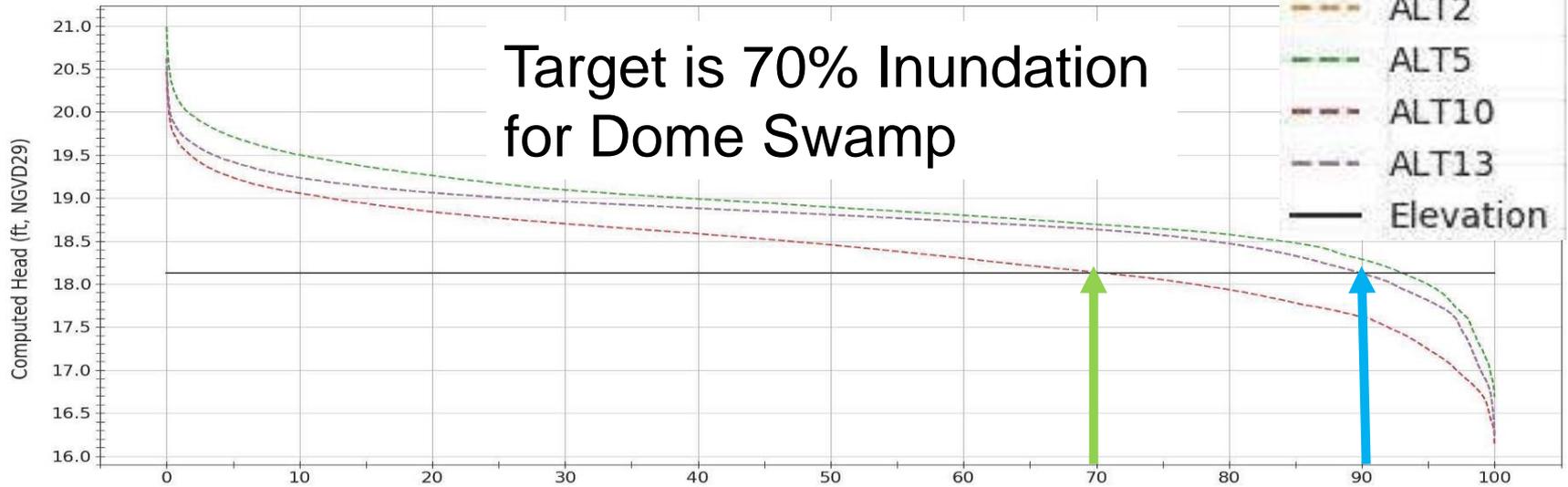
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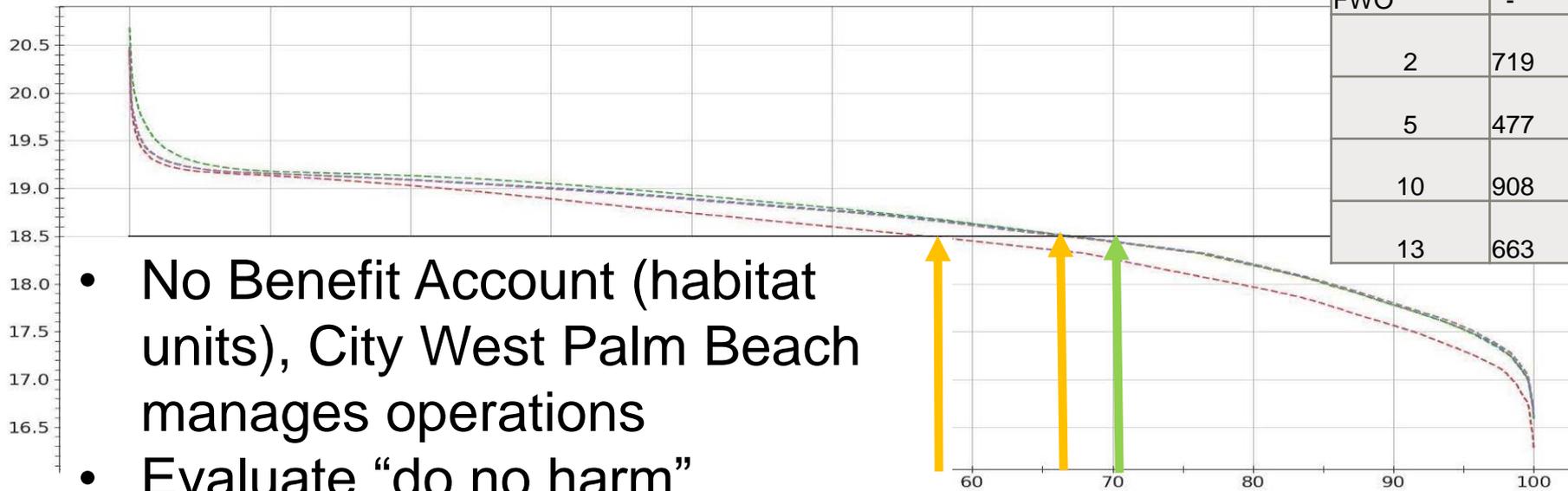
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# UPDATE 2: GRASSY WATERS PRESERVE (IR 5-10)

Duration Curve for GWP-9  
Elevation: 18.13 ft, NGVD29



Duration Curve for GWP-5.1  
Elevation: 18.50 ft, NGVD29



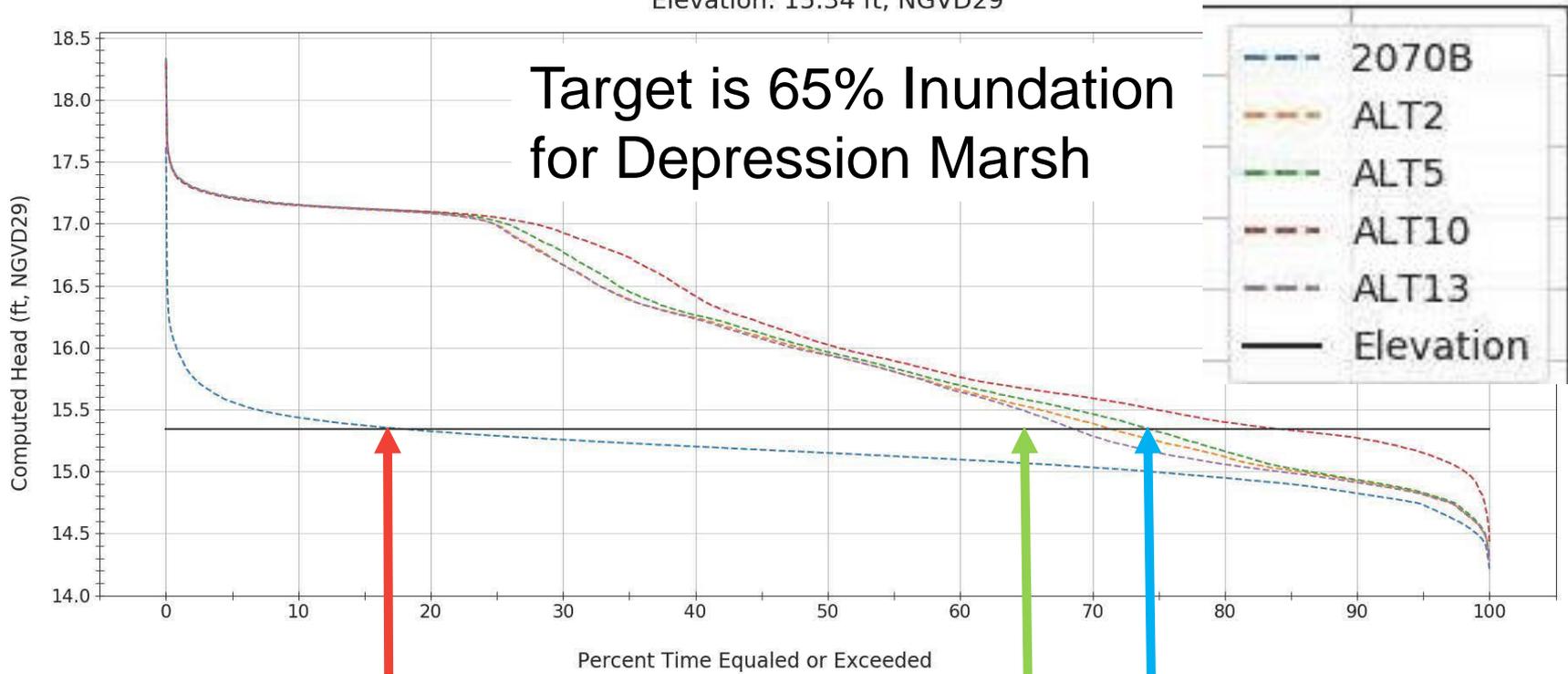
Alternative #	GWP lift
FWO	-
2	719
5	477
10	908
13	663

- No Benefit Account (habitat units), City West Palm Beach manages operations
- Evaluate “do no harm”

# UPDATE 3: OVERINUNDATION AND REVISED SCALING

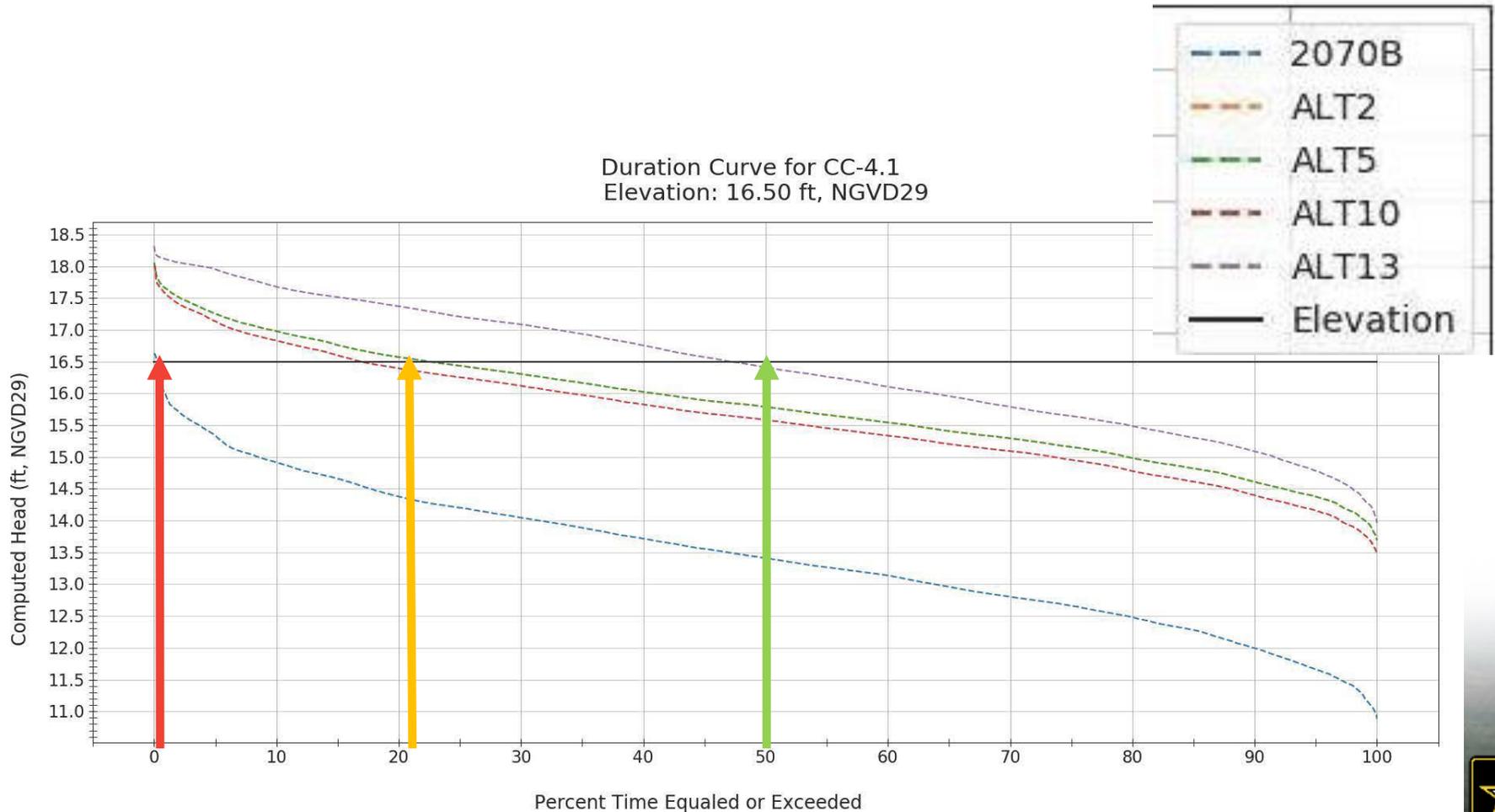
WL Type	min	max	Median	Range	Upper Range Ratio
DM	180	300	240	0.25	1.25
DS	210	300	255	0.18	1.18
FS	120	240	180	0.33	1.33
SS	210	300	255	0.18	1.18
WP	60	180	120	0.50	1.50

Duration Curve for LS-6A  
Elevation: 15.34 ft, NGVD29



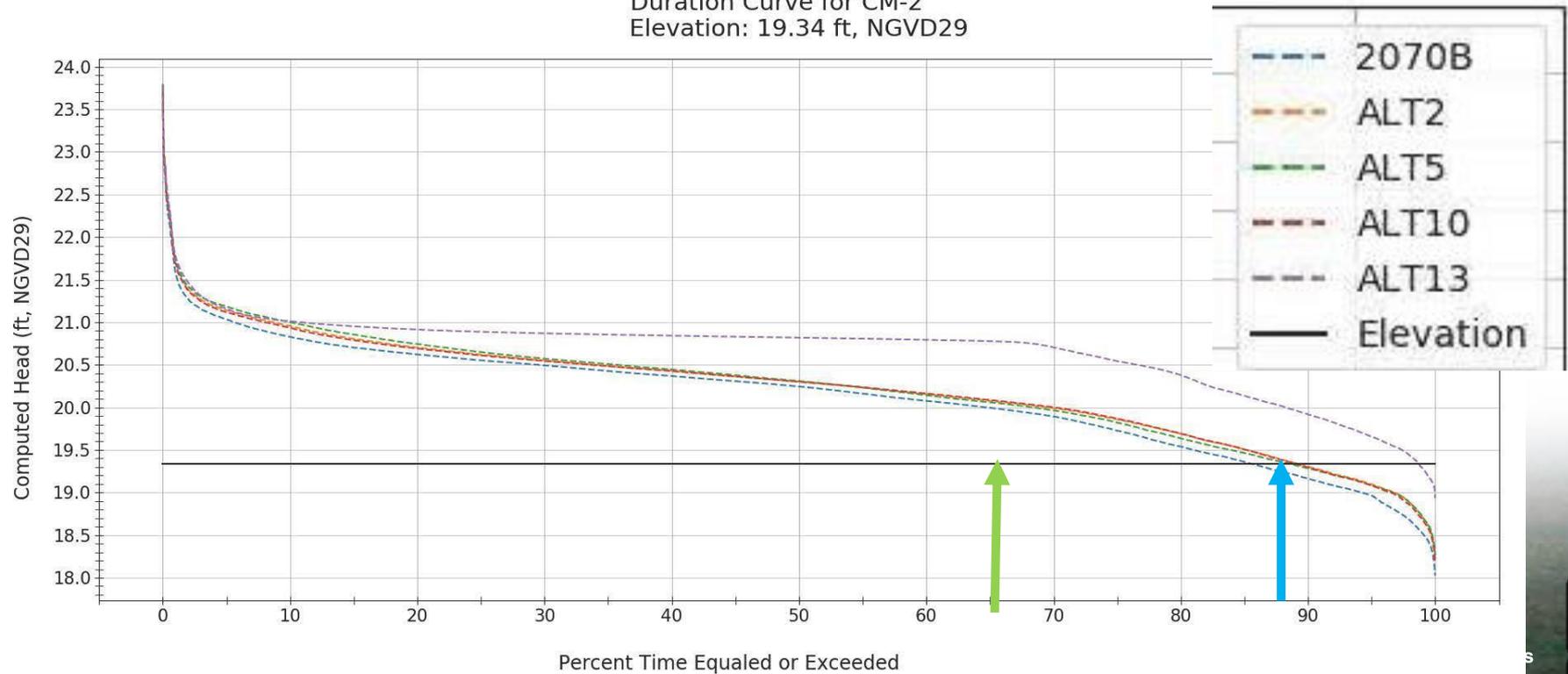
# TAKE HOME 1: FLOWWAY 3 CYPRESS CREEK AND SPREADER CANAL

Alt 13 Spreader canal lift > 1300 habitat units

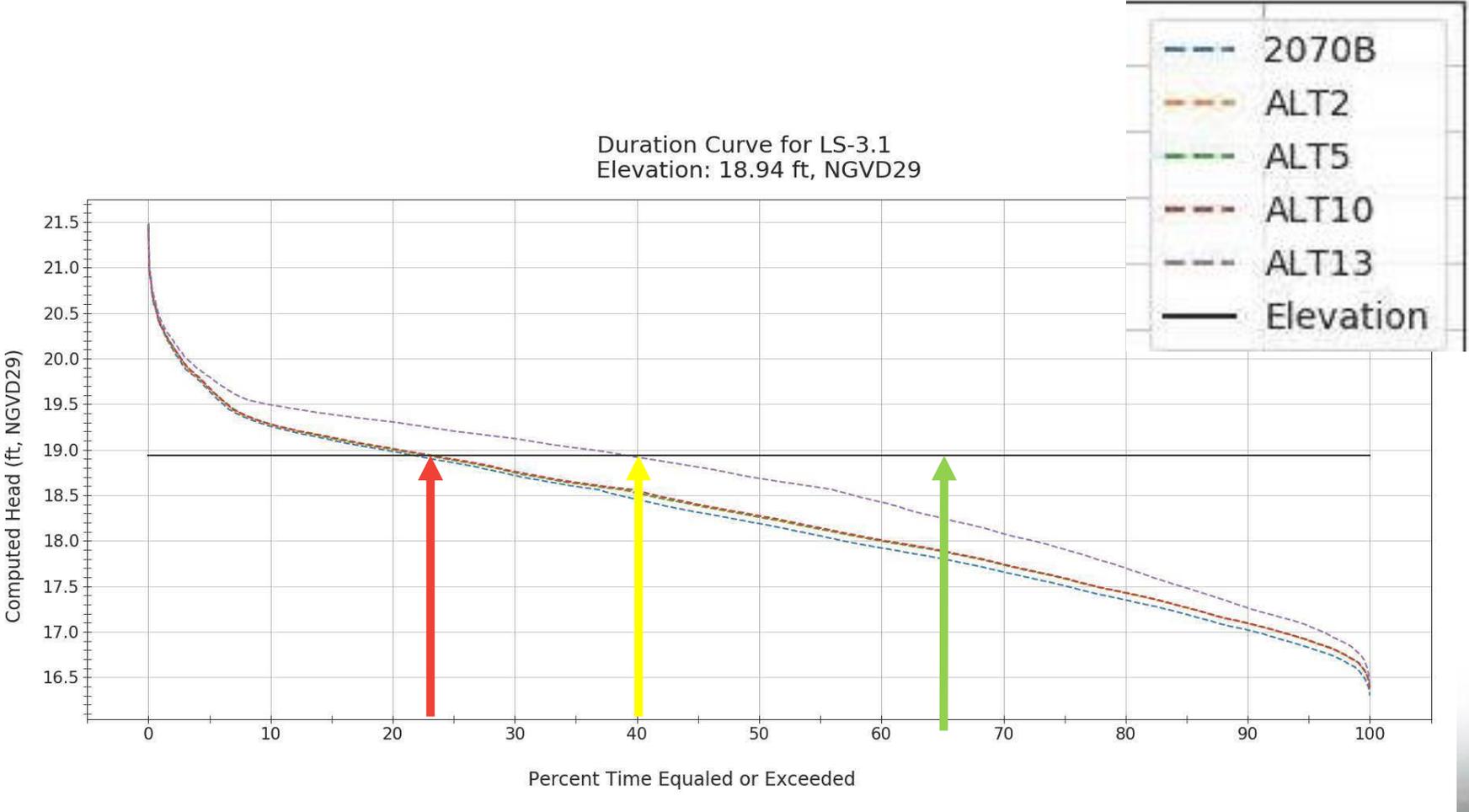


# TAKE HOME 2: CM-2 – AVENIR FLOWWAY – OVERINUNDATED IN BASE

Duration Curve for CM-2  
Elevation: 19.34 ft, NGVD29



# TAKE HOME 3: LOX SLOUGH IR3 – ALT 13 HIGHER LIFT



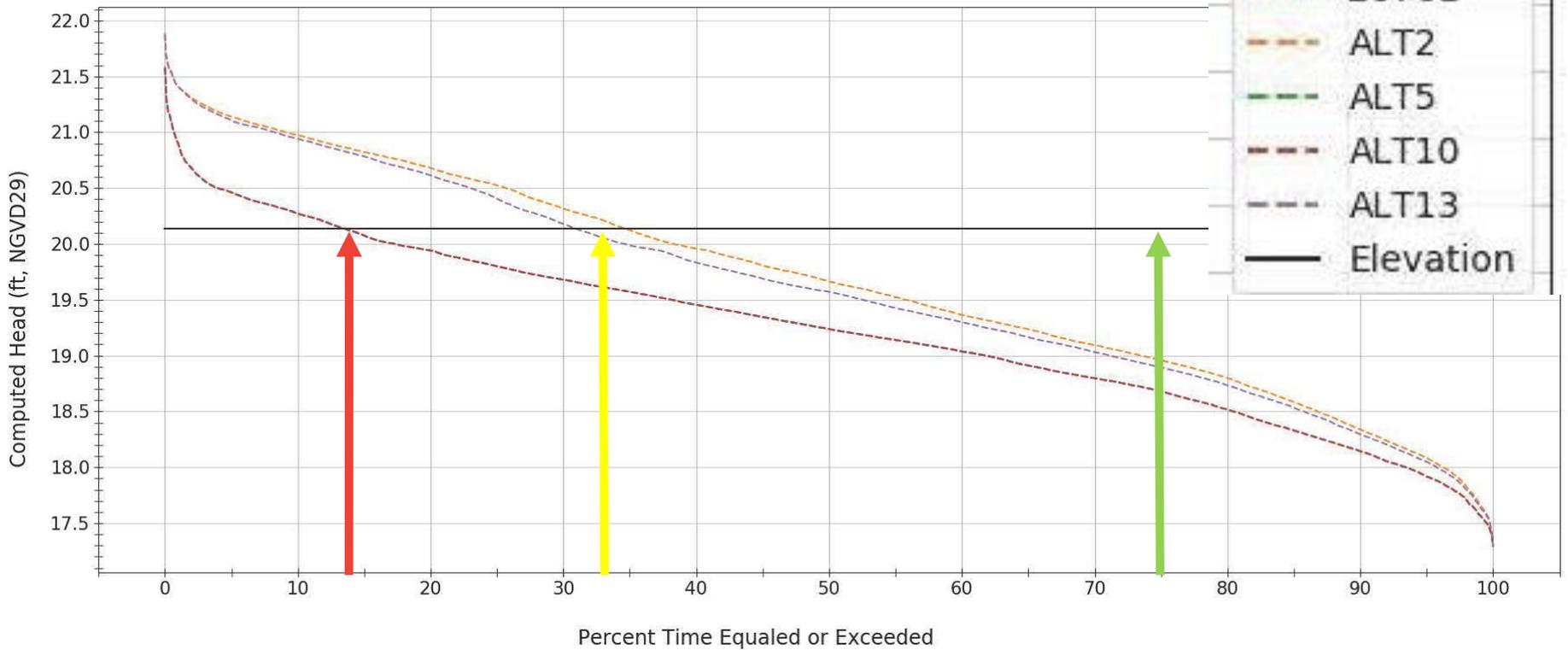
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# TAKE HOME 4: SHALLOW L-8 SEEPAGE TO CORBETT IR-3 (MOSS PROPERTY)

Duration Curve for C-3  
Elevation: 20.14 ft, NGVD29



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# PM-4 OUTPUT

## TAKE HOME 5: FLOWWAY 3 BIGGEST IMPROVEMENT

Alternative Performance without GWP Proper (Habitat Units)							
PM4-WRAP (worth 90%)	Flow-way	2014B	2070B	ALT2	ALT5	ALT10	ALT13
	FW1	5,487	5,477	6,999	7,009	6,988	6,970
	FW2	14,615	14,220	14,435	14,169	14,092	15,582
	<b>FW3</b>	<b>8,532</b>	<b>8,532</b>	<b>14,705</b>	<b>14,704</b>	<b>9,255</b>	<b>16,083</b>
	Subtotal	28,635	28,230	36,138	35,881	30,335	38,635
<b>Alt. Rank</b>				2.5	2.5	4	1



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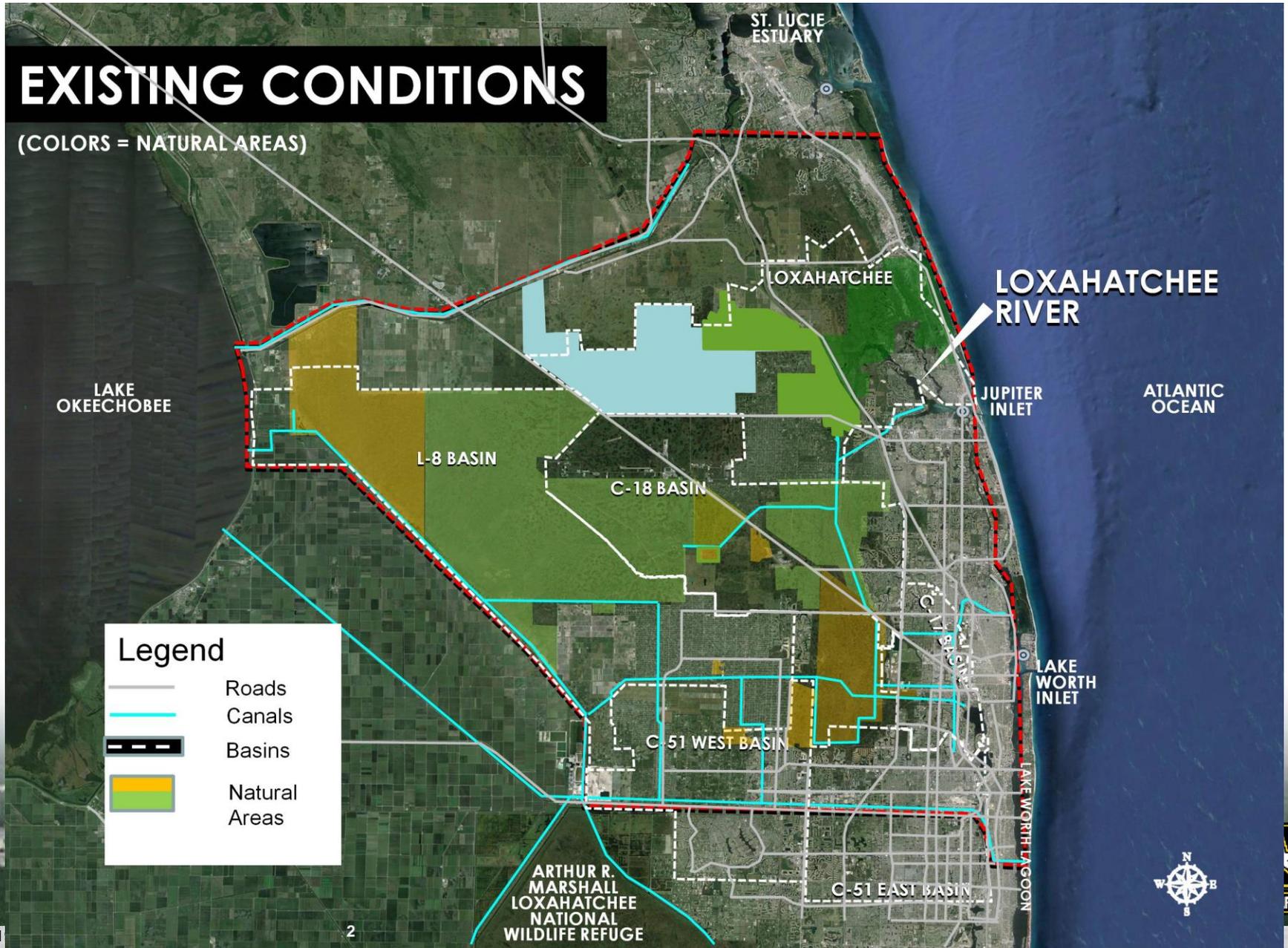


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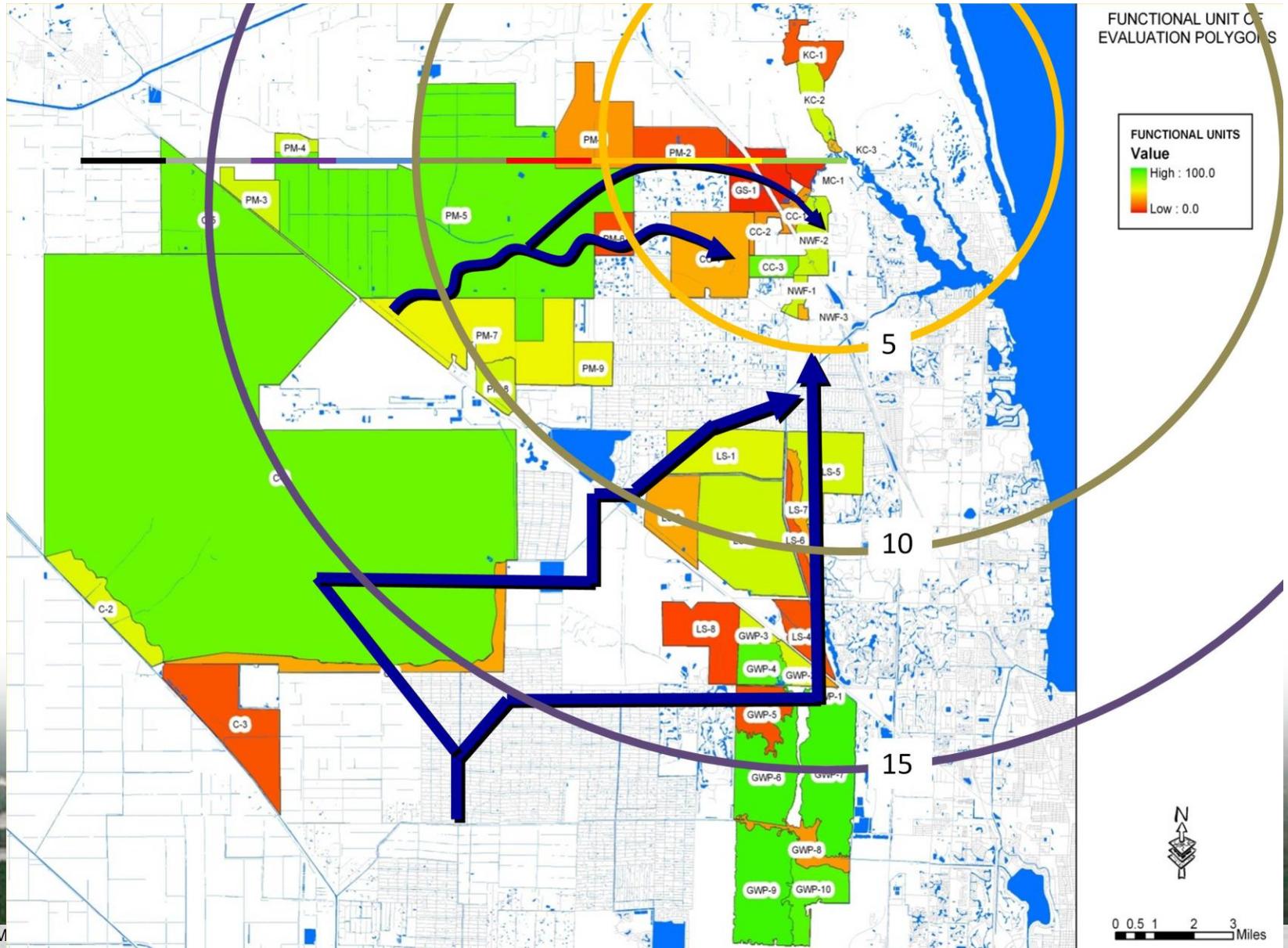
# PM-9 CONNECTIVITY FOUR CRITERIA

## EXISTING CONDITIONS

(COLORS = NATURAL AREAS)



# PM-9 CRITERIA 1 - HYDROLOGIC LINKAGE TO RIVER



# PM-9 CRITERIA 2 - GREENWAYS



Existing Greenways  
in Dark Green  
(FDEP, 2013)

## Florida Ecological Greenways Network



-  **Ecological Greenways Critical Linkages**
-  **Ecological Greenways Opportunities**
-  **Conservation Lands**



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# PM-9 CRITERIA 3 – INCIDENTAL WATER QUALITY IMPROVEMENTS

Score 0 - Connectivity and restoration actions do not provide additional water quality improvements.

Score 12.5 - Connectivity and restoration actions improves water quality by partially allowing for sheetflow across natural lands, natural flow ways providing some treatment, but also utilizing the canal system.

Score 25 - Connectivity and restoration actions improves water quality by allowing for only sheetflow across natural lands and natural flow ways.



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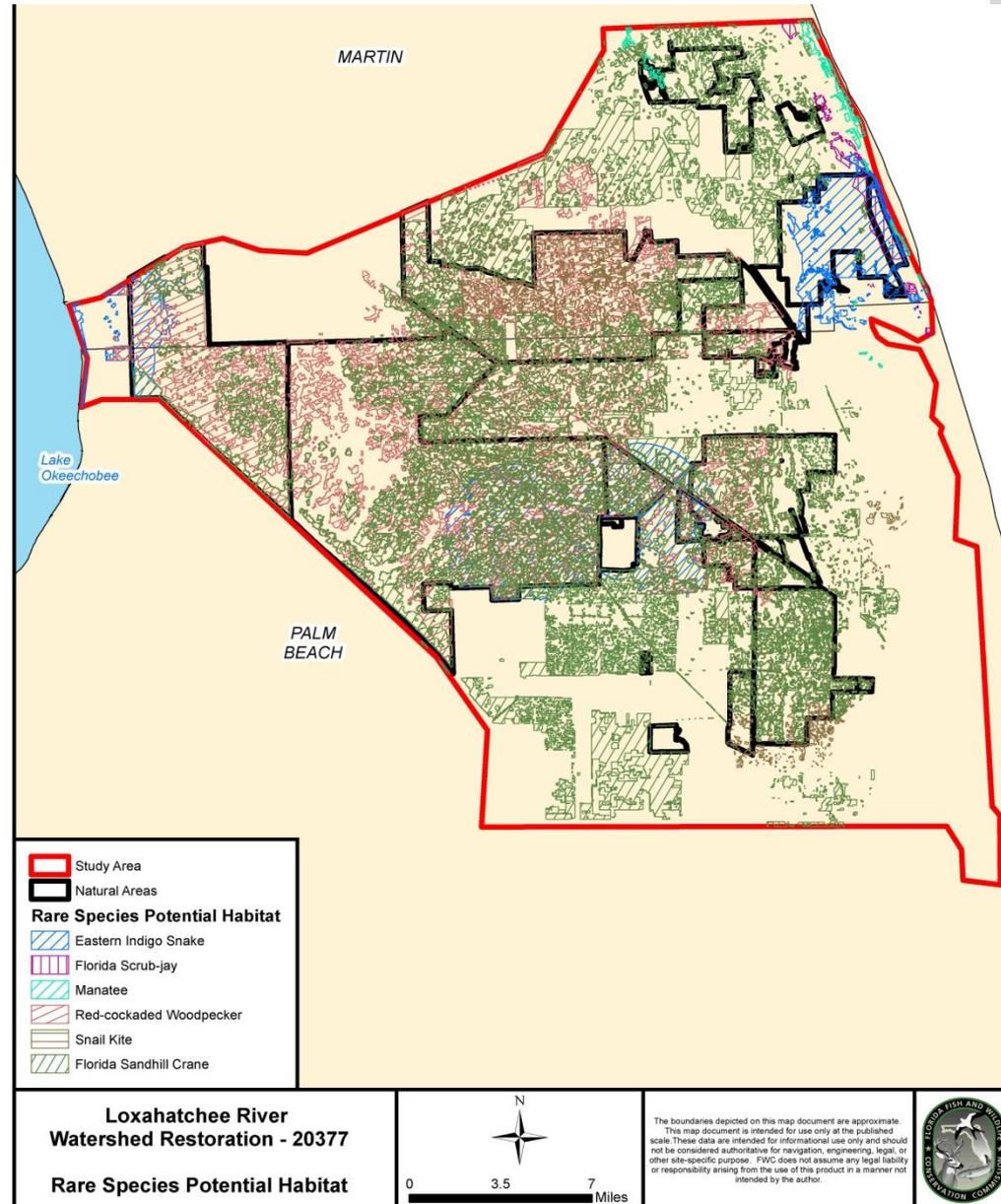
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# PM-9 CRITERIA 4 - FLORA AND FAUNA SPECIES

67 species of concern  
(state and Federal)  
potentially benefit from  
project

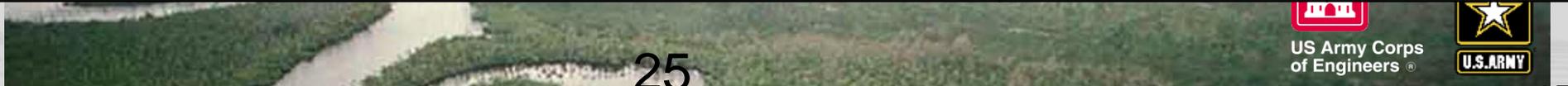
Three benefits of  
connectivity:

- 1) foraging range,
- 2) territory, or
- 3) migration path of listed or rare endemic species



# SCORING – NO= 0, PARTIAL = 12.5, YES = 25. TOTAL SCORE POSSIBLE IS 100

Hydrologic/Spatial Connectivity Matrix	Criterion Value Based on Subteam Assessment	Maximum Score Possible
<p>Connection provides historic hydrologic linkage which contributes to the restoration of downstream areas and improved quantity, timing and distribution of water. Connections that are closer to the river based on GIS analysis will be scored higher than those further away.</p>	12.5	25
<p>Connection is part of a proposed greenbelt.</p>	25	25
<p>Connectivity promotes water quality improvements and protects water quality.</p>	0	25
<p>Connectivity contributes to expanded native habitats and the support of wildlife populations by improving the following: 1) foraging range, 2) territory, or 3) migration path of listed or rare endemic species. Restoration actions address 2-3 of the criteria using maps of known species occurrences and potential habitats.</p>	12.5	25
<p><b>TOTAL SCORE</b></p>	50	100



25



# PM-9 PERFORMANCE

Total Possible Acres				
Flowway	ALT2	ALT5	ALT10	ALT13
FW1	9,654	9,654	9,654	9,654
FW2	43,373	43,373	43,373	43,373
FW3	25,312	25,312	25,312	25,312
Total	78,339	78,339	78,339	78,339
Connectivity Score by FW and Alt.				
Flowway	ALT2	ALT5	ALT10	ALT13
FW1	75	75	63	75
FW2	25	25	25	87
FW3	100	100	50	87
FW1	0.75	0.75	0.63	0.75
FW2	0.25	0.25	0.25	0.88
FW3	1.00	1.00	0.50	0.88
Total Score	0.67	0.67	0.46	0.83
<b>Total PM 9 Habitat Units</b>	<b>52,226</b>	<b>52,226</b>	<b>35,905</b>	<b>65,283</b>



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# WATERSHED HABITAT UNITS (BENEFITS)

Alternative Performance without GWP Proper							
	Flow-way	2014B	2070B	ALT2	ALT5	ALT10	ALT13
PM4-WRAP (worth 90%)	FW1	5,487	5,477	6,999	7,009	6,988	6,970
	FW2	14,615	14,220	14,435	14,169	14,092	15,582
	FW3	8,532	8,532	14,705	14,704	9,255	16,083
	Subtotal	28,635	28,230	36,138	35,881	30,335	38,635
	PM9 - Connectivity (worth 10%)	Subtotal	-	-	52,226	52,226	35,905
Watershed Habitat Units (0.9*PM4 HUs + 0.1*PM9 HUs)	<b>Total</b>	<b>25,771</b>	<b>25,407</b>	<b>37,747</b>	<b>37,516</b>	<b>30,892</b>	<b>41,300</b>
	<b>LIFT VS 2070B</b>	<b>364</b>	<b>-</b>	<b>12,340</b>	<b>12,109</b>	<b>5,485</b>	<b>15,893</b>
	% improve ment	-	-	49%	48%	22%	63%



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# HABITAT ANNUALIZATION – HOW LONG TO ACCRUE ACTUAL RESTORATION?

## Loxahatchee Watershed

0-2 Years	2-5 Years	5-10 Years	10-50 Years	75-100 Years
50%	70%	80%	90%	100%

## Loxahatchee River Northwest Fork Flood Plain

0-2 Years	2-5 Years	5-10 Years	10-50 Years	50-75 Years	75-100 Years
0%	30%	50%	75%	80%	100%

## Loxahatchee River Estuary

0-2 Years	2-5 Years	5-20 Years	20-50 Years
20%	75%	100%	100%



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# AVERAGE ANNUAL HABITAT UNIT LIFT

Alternative	Average Annual Lift			
	WL/ Connectivity HUs	River Floodplain HUs	Tidal River and Estuary HUs	Total River and Estuary HUs (floodplain + tidal)
ALT2	8,054	54	287	341
ALT5	8,095	66	348	414
ALT10	3,320	68	363	431
ALT13	11,133	40	210	250



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